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(54) Title: MULTI-PLY WIPE (57) Abstract <p>A basesheet for a wet wipe which includes multiple fibrous layers. At least one of the fibrous layers of the basesheet includes either 1) polyethylene fibers formed by a blend of polyethylene and an additive or 2) polypropylene fibers formed by a blend of polypropylene and an additive. For example, a fully hydrogenated hydrocarbon resin may be used as an additive with polyethylene to form polyethylene fibers which have a lower melting temperature of about 87 degrees Celsius. Polyethylene layers produced with such fibers may have an enhanced strength, produce less lint and be more securely attached to an adjacent fibrous layer. Polybutylene may be used as an additive with polypropylene to form polypropylene fibers to produce a more flexible layer with an increased attachment to an adjacent fibrous layer. The polyethylene and polypropylene layers may also include natural fibers such as cellulosic fibers. These polyethylene and polypropylene layers may both be present in a basesheet or may be combined with other fibrous layers. One or both of the major exterior surfaces of the generally planar basesheet may be formed by a polyethylene layer to provide the basesheet with a relatively soft exterior wiping surface. The polypropylene layer may be advantageously combined with a softer layer to provide strength and resiliency to the basesheet. A three ply basesheet may include an inner polypropylene layer and two outer polyethylene layers to thereby take advantage of the different properties of these layers. The use of an additive with either the polyethylene or polypropylene fibers allows the properties of the basesheet to be further controlled to suit the basesheet for its intended purpose.</p>		

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MULTI-PLY WIPE

Background of the Invention1. Field of the Invention

The present invention relates to multi-ply wipes. The invention particularly concerns
5 wet wipes which include a multi-ply basesheet.

2. Description of the Related Art

Wet wipes are well known and have been produced in many forms. One of the
most common forms of wet wipes is a stack of moistened sheets packaged in a plastic
container. Wet wipes have been made from a variety of materials and have been
10 moistened with a variety of suitable wiping solutions. Such wet wipes have been used for
baby wipes, hand wipes, household cleaning wipes, industrial wipes and the like.

Typically, conventional wet wipes have included a single layer of a substantially
homogeneous material. For example, such conventional wet wipes have been formed by
an air laid web of fibers which are uniformly mixed or distributed throughout the web.
15 Wipes have been formed by a variety of polymeric, synthetic and natural fibers such as
polyester, polyethylene, polypropylene and cellulosic fibers. Other conventional wet wipes
have included a coformed web of polypropylene and cellulosic fibers wherein the fibers
are uniformly mixed throughout the web.

The balance of physical properties, such as softness, flexibility, strength, integrity
20 and resiliency, of wet wipes is difficult to optimize when using only a single type of fiber or
fibers which are uniformly mixed throughout the thickness of the basesheet material. This
has been particularly true for those users desiring improved softness. For example,
certain fibers which may be used for wet wipes are stiffer and can provide strength and
resiliency but are not as soft or flexible as other fibers. Whereas other fibers, which may
25 also be used for wet wipes, are softer but may not have sufficient wet strength to
withstand the forces exerted by the user and may produce more lint than other fibers.

Summary of the Invention

The present inventors have recognized the difficulties and problems of the prior art
and in response thereto have developed a multi-ply wet wipe basesheet with improved
30 physical properties by including an additive in either the polypropylene or polyethylene
fibers used to form one of the plies or layers of the wet wipe basesheet. The use of such
an additive in a layered basesheet allows the physical properties of the basesheet to be
modified to suit the intended purpose of the wipe. For example, in a wipe intended to be
used in contact with skin, the layers of a wet wipe basesheet according to the present

invention may be combined to provide a soft and flexible wipe while still maintaining the strength, integrity and resiliency of the wipe.

In one embodiment, the present invention provides a layered basesheet for a wet wipe having a polypropylene and a polyethylene layer in mutual contact. In some
5 embodiments, two outer polyethylene layers are bonded to an inner polypropylene layer. An additive is present in either the polypropylene or polyethylene fibers and thereby modifies one or more of the physical properties of the fibers and resulting wipe. Natural fibers may also be included in one, several, or all of the basesheet layers.

In some embodiments, an additive which lowers the melting temperature of
10 polyethylene and which functions as a tackifier is added to the polyethylene fibers. A fully hydrogenated hydrocarbon resin additive may be used as a tackifier and to lower the melting temperature of linear low density polyethylene by more than 40 degrees from about 130 degrees Celsius to about 87 degrees Celsius.

In other embodiments of the invention, an additive, for example a polybutylene such
15 as a polybutene-1 copolymer, is present in the polypropylene fibers to increase the ply attachment or flexibility of the polypropylene layer. Another additive which may be used with the polypropylene fibers to increase their tackiness is polyethylene acrylic acid.

Other embodiments of the present invention provide a wet wipe with a basesheet
20 having at least two fibrous layers wherein one of the layers includes fibers formed by a blend which includes both polyethylene and an additive. The polyethylene fiber layer may also include natural fibers while the other fibrous layer may include natural fibers, synthetic fibers or both natural and synthetic fibers.

Further embodiments of the present invention provide a wet wipe with a basesheet
25 having at least two fibrous layers wherein one of the layers includes fibers formed by a blend which includes both polypropylene and an additive. The polypropylene fiber layer may also include natural fibers while the other fibrous layer may include natural fibers, synthetic fibers or both natural and synthetic fibers.

Embodiments of the present invention may take the form of a nonwoven layered wet
30 wipe basesheet which includes a first layer including polypropylene fibers and which has oppositely disposed first and second major surfaces; a second layer which includes polyethylene fibers and has an inward facing major surface and an oppositely disposed outward facing major surface wherein the inward facing surface is oriented towards and contacting the first major surface of the first layer and the outward facing surface of the second layer defines an exterior surface of the basesheet; and an additive which is
35 present in either the polypropylene fibers or the polyethylene fibers.

Embodiments of the present invention may also take the form of a nonwoven layered wet wipe basesheet which includes an inner layer including polypropylene fibers and having oppositely disposed first and second major surfaces; first and second outer layers each of which include polyethylene fibers and have an inward facing major surface and an oppositely disposed outward facing major surface, the inward facing major surfaces of the first and second outer layers being in respective contact with the first and second major surfaces of the inner layer, the outward facing major surfaces of the first and second outer layers defining two oppositely disposed major exterior surfaces of the basesheet; and an additive which is present in either the polypropylene fibers of the inner layer or the polyethylene fibers of the first and second outer layers.

Additional embodiments of the present invention may take the form of a wet wipe having a nonwoven basesheet which includes a fibrous first layer and a second layer; the fibrous first layer has oppositely disposed first and second major surfaces; the second layer including a plurality of fibers and has an inward facing major surface and an oppositely disposed outward facing major surface, the inward facing major surface being oriented towards and contacting the first major surface of the first layer and the outward facing major surface defining an exterior surface of the basesheet and wherein the fibers of the second layer include fibers formed by a blend of polyethylene and an additive; and a solution disposed in the basesheet.

Still further embodiments of the present invention may take the form of a wet wipe having a nonwoven basesheet which includes a first layer and a fibrous second layer; the first layer including a plurality of fibers and having oppositely disposed first and second major surfaces and wherein the fibers of the first layer include fibers formed by a blend of polypropylene and an additive; the fibrous second layer having an inward facing major surface and oppositely disposed outward facing major surface, the inward facing surface being oriented towards and contacting the first major surface and the outward facing major surface defining an exterior surface of the basesheet; and a solution disposed in the basesheet.

The present invention, in its various embodiments, provides several advantages. It allows different materials, including either polyethylene or polypropylene, to be combined to form a wet wipe basesheet in a manner which takes advantage of the different physical properties of the different materials. For example, the layers of the basesheet may be combined to take advantage of the relative strength provided by polypropylene fibers, the relative softness provided by polyethylene fibers, or both of these properties. Additionally, the use of an additive with either the polyethylene or the polypropylene fibers allows the

properties of the basesheet to be further controlled to better adapt the basesheet properties to the intended purpose of the wipe.

Detailed Description of the Invention

The present invention relates to multi-ply or layered basesheets for wet wipes.

5 Basesheets in accordance with the present invention may be used to form baby wipes, hand and face wipes, cosmetic wipes, household wipes, industrial wipes and other wet wipe products.

Wet wipe basesheet layers can be made from a variety of materials including meltblown materials, coform materials, air-laid materials, bonded-carded web materials, hydroentangled materials, spunbond materials and the like, and can comprise synthetic or
10 natural fibers. The layered basesheet may include a relatively soft layer which may include relatively soft and/or pliant synthetic fibers such as linear low density polyethylene fibers. The layered basesheet may also include a relatively strong, resilient layer which may include relatively resilient and high tensile strength synthetic fibers such as isotactic
15 polypropylene fibers.

The basesheets of the present invention are multi-ply basesheets which include at least two fibrous layers wherein one of the layers includes either polypropylene fibers or polyethylene fibers. The present invention may also advantageously combine two fibrous layers wherein a first layer includes polypropylene fibers and a second layer includes
20 polyethylene fibers. Additional fibrous layers which do not include polyethylene or polypropylene fibers may also be utilized in the basesheets.

A basesheet which includes both a polypropylene and polyethylene layer can take advantage of the different properties of both fibers. Polyethylene fibers are generally more pliant and therefore softer than polypropylene fibers. This is due to the inherent
25 differences between polyethylene and polypropylene in viscosity, structural chemistry and fiber solidification. A basesheet produced with polyethylene fibers will, accordingly, generally be softer than a similar basesheet produced with polypropylene fibers.

The same properties which increase softness, however, may also negatively impact other basesheet properties such as tensile strength, ply attachment, linting, and fiber
30 pilling. A basesheet produced with polypropylene will generally outperform a polyethylene basesheet in these latter properties but will not have the softness provided by a polyethylene basesheet.

Basesheets are generally planar with two oppositely disposed major exterior surfaces. The side edges of the basesheet are of limited surface area and are generally
35 not employed as wiping or cleaning surfaces by the end user of the wipe. Thus, to take

advantage of the softness provided by a polyethylene layer, the polyethylene layer can be used to define one or both major exterior surfaces of the basesheet. In a two ply basesheet, for example, a polyethylene layer may define one major exterior surface of the basesheet while in a three ply basesheet, polyethylene layers may be used to define both
5 of the major exterior surfaces of the basesheet.

Similarly, a polypropylene layer may be combined with a layer having greater softness to provide enhanced strength to the basesheet. As used herein and unless explicitly stated otherwise, a polyethylene layer or ply refers to a basesheet layer which includes polyethylene or polyethylene blend fibers. The polyethylene fibers may be
10 homopolymer fibers or bi-component fibers. The polyethylene layer may also include non-polyethylene fibers such as natural fibers. In a like manner, a polypropylene layer includes polypropylene or polypropylene blend fibers. The polypropylene fibers may be homopolymer or bi-component fibers. The polypropylene layer may also include non-polypropylene fibers such as natural fibers.

15 Additives may be blended into the polyethylene or polypropylene used to form the fibers. The presence of an additive in the polyethylene or polypropylene fibers may affect the properties of the polyethylene or polypropylene layer and provides another means by which the basesheet properties may be modified to adapt the basesheet for a particular use.

20 In accordance with one embodiment of the present invention, a polyethylene and polypropylene layer may be combined together to form a two ply basesheet. In such a basesheet, where the first layer includes polypropylene fibers and the second layer includes polyethylene fibers, the polypropylene first layer has oppositely disposed first and second major surfaces. Similarly, the polyethylene second layer has an inward facing
25 major surface and an outward facing major surface. The inward facing major surface of the polyethylene layer contacts the first major surface of the polypropylene layer. The outward facing major surface of the polyethylene layer defines an exterior surface of the basesheet and provides a relatively soft wiping surface while the polypropylene layer enhances the strength of the basesheet.

30 Either, or both, of the polyethylene and polypropylene layers may also include natural fibers. For example, the polypropylene layer may be a coformed layer of meltblown polypropylene microfibers and wood pulp fibers wherein the pulp to polymer weight ratio is from about 50/50 to about 75/25 and, advantageously, about 65/35. A suitable polypropylene is an isotactic polypropylene obtained from Montell USA Inc. of
35 Wilmington, Delaware under the trade designation MONTELL PF015. The polyethylene

layer may be a coformed layer of meltblown linear low density polyethylene microfibers and wood pulp fibers wherein the pulp to polymer weight ratio is from about 25/75 to about 75/25 and, advantageously, about either 50/50 or 65/35. A suitable polyethylene is available from Dow Chemical Co. under the tradename ASPUN 6831A.

5 Additional embodiments of the present invention may include additional fibrous plys. For example, a three ply basesheet may advantageously include an inner polypropylene layer and two outer polyethylene layers. In this manner, the outward facing surfaces of the two polyethylene layers may define both of the oppositely disposed major exterior surfaces of the basesheet. The inward facing major surfaces of the polyethylene layers
10 are disposed in contact with the two major surfaces of the polypropylene layer whereby the polypropylene layer may provide strength to the basesheet without having a negative impact on the softness of the major exterior surfaces of the basesheet. Natural fibers may also be included in one or more of the layers of such a basesheet.

Polyethylene and polypropylene fibers are thermally incompatible and generally do
15 not bond well to each other. The polyethylene and polypropylene fibers, however, may entangle with each other resulting in suitable securement between the layers. For example, in a layered basesheet containing a coform layer of polyethylene and cellulosic fibers and a coform layer of polypropylene and cellulosic fibers, the polyethylene and polypropylene fibers may entangle with each other and the cellulosic fibers and may at
20 least partially bond to the cellulosic fibers which results in securement between the layers. Such interlayer bonding and entanglement may be enhanced by a thermo-mechanical process wherein the layered basesheet is passed between a heated smooth anvil roll and a heated pattern roll.

The incorporation of an additive in either the polyethylene or polypropylene fibers
25 can also improve the level of attachment between adjacent polyethylene and polypropylene layers. The use of a tackifier as the additive may provide such results.

Various tackifiers are known in the art and may be used to improve the adhesive or bonding properties of fibers in which they are incorporated. Tackifiers may be effectively added to materials with which the tackifier has a limited compatibility. Tackifiers often
30 have molecular weights which have a broad distribution and fall within the range of 500-2000. The softening points of such tackifiers may vary from 50 to 150 degrees Celsius.

Tackifiers can improve the adhesion of an elastomeric material by reducing the material's resistance to deformation at low rates of deformation (thereby facilitating bond formation upon contact) while increasing the resistance to deformation at higher rates of
35 deformation (thereby providing a stronger resistance to detachment). By reducing elastic

recovery and facilitating plastic deformation, the tackifier may enable the adhesive mass to contact the surface more intimately, thus enhancing bond strength. This functionality of tackifiers is well-known and can be quantified or verified for a particular elastomeric material and tackifier by comparing the shear storage modulus of the elastomeric material with and without the tackifier.

It has been found that when polyethylene fibers for a wet wipe basesheet are produced using a blend of polyethylene and a fully hydrogenated hydrocarbon resin additive, such as the tackifier REGALREZ 1126® produced by Hercules Inc. having offices in Wilmington, Delaware, the peel strength of the adjacent polyethylene and polypropylene layers can be significantly enhanced. The ply attachment, or peel strength, of adjacent layers may be measured in a manner described below in the description of examples.

Furthermore, it has been found that a polyethylene blend containing 80% polyethylene and 20% REGALREZ 1126® produces fibers having a melting temperature of approximately 87 degrees Celsius. This compares to a melting temperature of approximately 130 degrees Celsius for the virgin polyethylene used to form the blend.

By reducing the melting temperature of the polyethylene fibers, and in the absence of a corresponding drop in the processing temperature, it is thought that the fibers are likely to remain in a semi-molten state for a longer period of time during the formation of the polyethylene layer in comparison to the virgin polyethylene. It is also thought that this may allow for the formation of more bonds between the individual polyethylene fibers. It is postulated that the presence of additional bonds would increase the tensile strength of the layer, reduce the amount of lint and improve the attachment between the polyethylene layer and the adjacent fibrous layer. Thus, while the "tackifying" attributes of the REGALREZ® 1126 are considered to be primarily responsible for any increase in the number of fiber to fiber bonds, it is also thought that the reduction in the melting temperature of the resultant polyethylene blend may have a potentially beneficial and incremental effect on the number of such bonds.

It can be readily appreciated that an increased number of fiber to fiber bonds will increase the tensile strength of the layer. It is thought that an increased number of fiber to fiber bonds within the polyethylene layer reduces two types of lint. All polyethylene layers are capable of producing polyethylene lint, i.e., polyethylene fibers which are separated from the basesheet. When the polyethylene layer further includes natural or other fibers, the loss of these other fibers will also produce lint. It follows, that when there is an increase in the fiber to fiber bonding of the polyethylene fibers, there are fewer loose

polyethylene fibers and the individual polyethylene fibers are generally more securely bonded to the layer. Thus, fewer polyethylene fibers are likely to become loose and produce polyethylene lint. It also follows that an increase in fiber to fiber bonding for the polyethylene fibers will provide a tighter network of fibers which will enhance the mechanical capture of any non-polyethylene fibers present in the layer thereby also reducing this second source of lint.

The increased fiber to fiber bonding among the polyethylene fibers is also thought to improve ply attachment. The individual polyethylene fibers which do bond to, or become entangled with, fibers in the adjacent layer are likely to be more strongly secured to other fibers within the polyethylene layer when there are more fiber to fiber bonds between polyethylene fibers and thus provide a relatively stronger attachment between layers.

Increasing the number of fiber to fiber bonds, however, may also reduce the softness of the polyethylene layer. Basesheet layers containing (by weight) 65% cellulosic pulp and 35% polyethylene fibers formed with a blend containing 80% polyethylene and 20% REGALREZ 1126® may be perceived by some individuals to be less soft than a layer formed with 65% cellulosic pulp and 35% virgin polyethylene. It is thought that the increased number of polyethylene fiber bonds may reduce the pliancy of the polyethylene fibers and thereby affect the tactile properties of the fibers in a manner which is perceptible for some individuals.

It has also been found that the use of an additive with polypropylene fibers can improve the level of attachment between adjacent layers of polypropylene and polyethylene. For example, the use of polybutylene as an additive can increase the tackiness of the polypropylene fibers, and, at levels of 20% and 50%, was found to have a positive effect on ply attachment.

The use of polybutylene as an additive was also found to be capable of reducing the stiffness of the basesheet. A reduction in the stiffness, i.e., an increase in the flexibility, of the basesheet generally has a positive influence on the tactile perception of the basesheet. Moreover, an increase in flexibility can occur in an inner ply which does not form one of the major exterior surfaces of the basesheet and still produce this positive influence on the tactile perception of the basesheet.

Polyethylene acrylic acid is another additive which may be incorporated into the polypropylene fibers, either by itself or in combination with polybutylene, to enhance the tackiness of the polypropylene fibers. The blending of a polyethylene acrylic acid with polypropylene is described in U.S. Pat. No. 4,797,318 which is incorporated herein by reference.

In a further embodiment of the present invention, a basesheet having a polyethylene layer and at least one additional fibrous layer is provided. The fibers of the polyethylene layer include polyethylene fibers formed with a blend containing both polyethylene and an additive. The polyethylene layer may also include natural fibers. The fibers of the additional fibrous layer may be either synthetic, natural or a mixture of synthetic and natural fibers.

Similarly, in yet another embodiment of the present invention, a basesheet having a polypropylene layer and at least one additional fibrous layer is provided. The fibers of the polypropylene layer include polypropylene fibers formed with a blend containing both polypropylene and an additive. The polypropylene layer may also include natural fibers. The fibers of the additional fibrous layer may be either synthetic, natural or a mixture of synthetic and natural fibers.

Natural fibers such as cellulosic fibers may be used in the wet wipe basesheet to provide enhanced thickness and wettability. The natural fibers may also provide void volume within the basesheet which may increase the moisture capacity of the basesheet.

Examples of natural fibers suitable for use in the present invention include not only cellulosic fibers such as wood pulp fibers, but also cotton fibers, flax fibers, jute fibers, silk fibers and the like. In addition to polyolefins such as polypropylene and polyethylene, examples of thermoplastic polymeric fibers suitable for use with the present invention include polyamides, and polyesters such as polyethylene terephthalate. Alternative synthetic fibers which may be suitable include staple nylon and rayon fibers.

If a layer of the multi-ply basesheet is a combination of synthetic and natural fibers, such as polypropylene and cellulosic fibers, the relative percentages of the synthetic fibers and natural fibers in the layer can vary over a wide range depending on the desired characteristics of the wet wipes. For example, the layer may comprise from about 20 to about 95 weight percent, desirably from about 20 to about 60 weight percent, and more desirably from about 30 to about 40 weight percent of synthetic fibers based on the dry weight of the layer. Such a layer of synthetic and natural fibers may be manufactured by methods well known to those skilled in the art.

Generally, it is desirable that a layer containing both synthetic and natural fibers be formed by a coform process which provides a generally uniform distribution of the synthetic and natural fibers within the individual layer. The manufacture of coform layers is described in U.S. Patent No. 4,100,324 to Anderson et al. which issued July 11, 1978; U.S. Patent No. 4,604,313 to McFarland et al. which issued August 5, 1986; and U.S. Patent No. 5,350,624 which issued September 27, 1994; the disclosures of which are

herein incorporated by reference. Typically, such coform layers comprise a matrix of thermoplastic polymeric meltblown microfibers, such as polypropylene microfibers, and cellulosic fibers, such as wood pulp fibers. A coform layer is formed by initially forming at least one primary air stream containing the synthetic fibers and merging the primary
5 stream with at least one secondary stream of natural fibers. The primary and secondary streams are merged under turbulent conditions to form an integrated stream containing a homogeneous distribution of the fibers. The integrated air stream is directed onto a forming surface to air form a layer of material. A multiplicity of these coform layers can be formed in succession to provide a web of multiple coform layers.

10 As previously mentioned, the attachment of polyethylene and polypropylene coform layers may be enhanced by a thermo-mechanical process wherein the layered basesheet is passed between a heated smooth anvil roll and a heated pattern roll. The pattern roll may have any raised pattern which provides the desired entanglement and interlayer bonding. Desirably, the pattern roll defines a raised pattern which defines a plurality of
15 bond locations which define a bond area of between about 4 and about 30 percent of the total area of the roll.

The pressure between the rolls and the temperature of the rolls must be balanced to produce a basesheet having adequate strength and integrity while maintaining the softness of the outer layers. The temperature and pressure may vary depending upon the
20 types of fibers being used to provide the desired wet wipe. In a particular embodiment wherein the layers comprise at least one layer of polyethylene fibers and at least one other layer of polypropylene fibers, the pressure between the rolls may be between about 50 and about 900 newtons per lineal centimeter and the temperature of at least one of the rolls may be between about 40 and about 150 degrees Celsius for improved entanglement
25 and bonding. Under such conditions of temperature and pressure, the polyethylene fibers deform to provide mechanical entanglement with and possible bonding to the polypropylene fibers. As a result, the layers become entangled and bonded in discrete areas arranged in a pattern which corresponds to the raised pattern on the pattern roll.

The multi-ply basesheet may have a total basis weight of from about 25 to about
30 120 grams per square meter and desirably from about 40 to about 90 grams per square meter. The basis weight of the basesheet may also vary depending upon the desired end use of the wet wipe. For example, a suitable basesheet for wiping the skin may have a basis weight of from about 60 to about 80 grams per square meter and desirably about 75 grams per square meter. In other embodiments the layered basesheet may include
35 coform layers of polypropylene and cellulosic fibers and polyethylene and cellulosic fibers

and have a basis weight of from about 60 to about 90 grams per square meter and desirably about 80 grams per square meter.

Each layer of the basesheet may or may not have the same basis weight depending upon the desired properties of the wet wipe. For example, in a three layer coform basesheet which includes an inner layer of polypropylene and wood pulp fibers and two outer layers of polyethylene and wood pulp fibers, the basis weight of the layers may define an outer/inner/outer layer weight ratio of from about 10/80/10 to about 40/20/40, desirably about 25/50/25 to about 33/33/33 and more desirably about 30/40/30 based on a total weight of the basesheet.

The basesheet should have sufficient strength to withstand the forces exerted by the user when it is wetted with solution. In a basesheet which includes layers of both polypropylene and polyethylene layers, the layer which includes polypropylene fibers will generally provide the majority of the basesheet strength while the polyethylene fibers may be used to provide a soft exterior surface for the wet wipe. Thus, the tensile strength of such a layered basesheet may be higher than the tensile strength of a single layer containing polyethylene fibers and provide softer exterior surfaces than a single layer containing polypropylene fibers.

Multi-ply basesheets in accordance with the present may be manufactured on a single manufacturing line which includes multiple individual forming banks. Each forming bank is configured to provide an individual ply or layer. For example, the first and last forming banks may be configured to provide the outer layers while the middle or interior forming banks may be configured to provide one or more inner layers. The mechanical entanglement of fibers in adjacent layers during the forming process attaches the adjacent layers. Bonds may also form between fibers of adjacent layers to provide further attachment of the adjacent layers of the basesheet. Subsequent thermomechanical bonding may also be used to improve the attachment between the adjacent layers.

Each forming bank will include the appropriate equipment to provide the desired type of web. For example, if each layer comprises a coform layer of meltblown microfibers and natural fibers such as wood pulp fibers, each forming bank may include a plurality of meltblowing dies to extrude a molten polymeric material in fine streams. The fine streams are then attenuated by converging flows of high velocity gas to break the polymer streams into discrete microfibers of small diameter. Such meltblowing dies are well known to those skilled in the art. The stream or streams of natural fibers which are converged with the streams of meltblown microfibers may be provided by a conventional pulp picker roll process as is well known to those skilled in the art.

Alternatively, one or more layers of the wet wipe basesheet can be made from a different type of material such as a meltblown sheet of polymeric microfibers. For example, an inner, strong and resilient layer may be formed with a layer of meltblown polypropylene fibers while soft outer layers may be formed with coform layers of polyethylene and wood pulp fibers as described above. Soft and flexible outer layers may also be provided by different types of materials such as airlaid, carded web, or meltblown materials which are manufactured by processes well known to those skilled in the art.

The basesheet of the present invention is used to form a wet wipe by adding an appropriate solution to the basesheet. The solution may be any liquid which can be absorbed into the wet wipe basesheet and may include a variety of different components which provide the desired wiping properties. For example, the components may include water, emollients, surfactants, fragrances, preservatives, chelating agents, pH buffers or combinations thereof as are well known to those skilled in the art. The solution may also contain lotions and/or medicaments.

The amount of solution contained within each wet wipe may vary depending upon the type of material forming the basesheet, the type of solution being used, the type of container being used to store the wet wipes, and the intended use of the wet wipe. Generally, each wet wipe will contain from about 150 to about 600 weight percent and desirably from about 250 to about 450 weight percent solution based on the dry weight of the basesheet. It is generally desirable that the amount of solution contained within the wet wipe be from about 300 to about 400 weight percent and, advantageously, about 330 weight percent based on the dry weight of the basesheet.

If insufficient solution is added to the basesheet, the resulting wet wipe may be too dry and may not adequately perform. If excessive solution is added to the basesheet, the resulting wet wipe may be oversaturated and soggy and the solution may pool in the bottom of the container.

Basesheets, and resulting wet wipes, are generally rectangular in shape and may have any suitable unfolded width and length. For example, the wet wipe may have an unfolded length of from about 2.0 to about 80.0 centimeters and desirably from about 10.0 to about 25.0 centimeters and an unfolded width of from about 2.0 to about 80.0 centimeters and desirably from about 10.0 to about 25.0 centimeters. Typically, individual wet wipes are arranged in a folded configuration and stacked one on top of the other to provide a stack of wet wipes. Such folded configurations are well known to those skilled in the art and include c-folded, z-folded, quarter-folded and similar configurations.

A stack of folded wet wipes may be placed in the interior of a container, such as a plastic tub, to provide a package of wet wipes for eventual sale to the consumer. If the stack is interfolded, the wipes may be conveniently dispensed using what is commonly referred to as a "pop-up" dispenser. Alternatively, the wet wipe basesheets may form a continuous strip of material which has perforations between each individual wipe. A continuous strip of basesheet material may be arranged in a stack or wound into a roll for dispensing.

Examples

The following examples are presented to provide a more detailed understanding of the invention. The particular materials and parameters are exemplary and are not intended to limit the scope of the invention.

A matrix of additives and fibrous layers was developed to compare the efficacy and properties of different additives. Separate samples according to each code were prepared and compared. Each of the samples was a two-layer material having a polyethylene coform layer and a polypropylene coform layer. To facilitate comparison of the different samples, each of the basesheet samples had a target basis weight of 54 grams per square meter (gsm) and each sample layer included 65% cellulosic pulp by weight.

The different samples are listed in the following table:

Code No.	Polyethylene Coform Layer	Polypropylene Coform Layer
1	PE	PP
2	PE + 10% Hydrocarbon Resin	PP
3	PE + 20% Hydrocarbon Resin	PP
4	PE	PP + 20% Polybutylene
5	PE	PP + 50% Polybutylene
6	PE	PP + Atactic Polypropylene

PE = polyethylene

PP = polypropylene

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The hydrocarbon resin added to the polyethylene of codes 2, 3 and 7 was REGALREZ 1126® which is a fully hydrogenated hydrocarbon resin produced by Hercules Inc. having offices in Wilmington, Delaware. This resin is produced by

polymerization and hydrogenation of pure monomer hydrocarbon feedstocks and is a highly stable, light-colored, low molecular weight, nonpolar resin.

When forming the polyethylene fibers which included fully hydrogenated hydrocarbon resins (codes 2 and 3), it was found that the hydrocarbon resin pellets were relatively "sticky." To improve processing, the hydrocarbon resin pellets were compounded into the polyethylene and the resulting blend was re-pelletized in a twin screw extrusion process. The blended pellets were then used to form the polyethylene fibers. For the codes using a hydrocarbon resin additive, i.e., codes 2 and 3, the polyethylene and hydrocarbon ply was formed in a process wherein the extrusion temperature was 243°C (470°F), the air temperature of the primary air stream conveying the polyethylene fibers was 277-282°C (530-540°F); and the forming height was 25.4-27.9 cm (10-11 inches). When forming plies containing polyethylene fibers without an additive, the extrusion temperature was 249°C (480°F), the air temperature of the primary air stream conveying the polyethylene fibers was 277-282°C (530-540°F), and the forming height was 25.4-30.5 cm (10-12 inches).

The polybutylene was obtained under the tradename Shell DP 8911 from Shell Chemical Co. having offices in Houston, Texas and has since become available under the tradename DURAFLEX 8911 from Montell USA Inc. The atactic polypropylene was obtained under the tradename REXTAC-2115 from Huntsman, Inc. having offices in Houston and Odessa, Texas. For the codes using a polybutylene additive, i.e., codes 4 and 5, the polypropylene and polybutylene ply was formed in a process wherein the extrusion temperature was 243°C (470°F), the air temperature of the primary air stream conveying the polypropylene fibers was 268-288°C (515-550°F), and the forming height was 25.4-30.5 cm (10-12 inches). When forming plies containing polypropylene fibers without an additive, the extrusion temperature was 260°C (500°F), the air temperature of the primary air stream conveying the polypropylene fibers was 288°C (550°F) and the forming height was 27.9 cm (11 inches).

The polyethylene was a linear low density polyethylene and was obtained under the tradename ASPUN 6831 from Dow Chemical having offices in Midland, Michigan. The polypropylene was obtained under the tradename Montell PF015 from Montell USA Inc. having offices in Wilmington, Delaware.

Code 1 did not include an additive in either the polyethylene fibers or the polypropylene fibers and was used as a control. Two versions of code 1 were produced; a "PE control" in which a polyethylene coform layer was formed on a polypropylene coform layer already present on the web former; and a "PP control" in which a

polypropylene coform layer was formed on a polyethylene coform layer already present on the web former.

Codes 2 and 3 were formed in the same fashion as the PE control, i.e., the polyethylene coform layer was formed onto the polypropylene coform layer. Thus, the effectiveness of the additives used in Codes 2 and 3 is most directly determinable by a comparison to the PE control. Codes 4-6, on the other hand, were formed in the same fashion as the PP control, i.e., the polypropylene coform layer was formed onto the polyethylene coform layer. Thus, the effectiveness of the additives used in Codes 4-6 is most directly determinable by a comparison to the PP control.

The peel strength, linting, cup crush and tensile strength (in both the machine direction "MD" and cross machine direction "CD") of the samples was tested to provide a relative comparison of the different samples for these physical parameters.

180° Peel (T-Peel) Strength

Prior to peel testing, the samples were each bonded with a similar pattern. The bonding pattern bonded approximately 13% of the surface area of the sample. The bonding was conducted at a pressure of about 131.3 Newtons per lineal centimeter (75 pounds per linear inch). The average hot oil core temperature of the bonder was approximately 77°C (170°F), and the bonding temperature was estimated to be approximately 68 to 71°C (155 to 160° F).

The peel test samples were prepared by first cutting a 7 inch by 7 inch section of wipe and adding solution to the wipe whereby the wipe contains solution in the amount of 330% of the dry weight of the wipe. The solution is the same solution as is used with Huggies® Wet Wipes which are commercially produced by Kimberly-Clark Corp. having offices in Neenah, WI (deionized water may be used as an alternative solution). A 2 ± 0.04 inch (13 ± 1 mm) by 7 ± 0.04 inch (152 ± 1 mm) sample is then cut from the saturated wipe with the longer side running parallel to the machine direction. The edges on the sample must be clean cut and parallel.

A Constant Rate of Extension unit (or tensile tester) equipped with an appropriate load cell and computerized data acquisition system is used to perform the peel strength test. Appropriate tensile testers and load cells may be obtained from Instron Corp. of Canton, MA or Sintech, Inc. of Research Triangle Park, NC.

The grips of the tensile tester are installed parallel to each other. The tensile tester settings are as follows: the crosshead speed is set at 20 ± 0.04 inch/min (508 ± 10

mm/min); the gage length is set at 1.0 ± 0.04 inch (25 ± 1 mm); the Start Measurement is set at 0.5 ± 0.04 inch (13 ± 1 mm); and the End Measurement is set at 6 ± 0.04 inch (152 ± 1 mm).

The test is conducted by first manually separating the polyethylene and polypropylene layers at one end of the sample. The plys are separated for a length of approximately 1 inch and no more than 2 inches. The two layers are then placed in opposite grips of a testing device so that the sample is straight and without slack. The testing device is then used to pull apart the layers (whereby the separated layers form a 180° angle) at the specified rate while simultaneously recording the force necessary to separate the layers in grams of force.

Linting

For the measurement of sheet linting, a modified Gelbo unit was used. A suitable testing unit may be obtained from US Testing Co., Inc., PO Box 3189, 1415 Park Avenue, Hoboken, NJ 07030. This test is used to determine the relative quantity of particles released from a fabric when it is subjected to a continuous flexing and twisting movement.

At least five basesheets are used for any sample determination. At least seven basesheets should be initially collected, reserving the top and bottom basesheets for specimen protection only. The test specimens should be clean, dry, and free from environmental contamination. The test specimens should also be free of folds, wrinkles, and any other distortion which would constitute an abnormality. Performing the test on six to ten specimens is typically sufficient to provide a reasonable degree of confidence for obtaining an average sample value. Outlying values may be excluded when computing the average sample value.

To perform the test, a dry 9" x 9" (23 cm by 23 cm) basesheet is placed in the modified Gelbo flexing unit where the sheet is strapped between two discs which hold the sheet in a tubular configuration. The sheet is carefully mounted, and with minimal handling, while the flexing heads are extended to their maximum distance. The specimen should have a gap at the top position of the tube formed by the sheet and the machine direction of the sheet should correspond to the long axis of the tube.

The sheet is then turned and flexed to emit lint for a period of five minutes. The two holders have a flexing stroke of 4.7 in. (119.8 mm) and there is a twist to the shaft of 180° and a stroke rate of about 60 cycles per minute. After five minutes, the sheet is removed and the amount of emitted lint is determined.

Due to the amount of lint produced, the measurement of the lint is performed by measuring the basis weight of the sheet before and after flexing the sheet rather than using a particle counter. Weighing the samples rather than using a particle counter also obviates the necessity to perform the testing in a laminar flow hood or a class 100 clean room, or enclose the flexing unit within a Plexiglas® chamber which has been cleaned and purged with filtered air.

The test equipment should be located in, and the samples conditioned to, a common testing atmosphere. The testing atmosphere should conform to either ASTM conditions ($65 \pm 2\%$ RH and $72 \pm 2^\circ$ F) or TAPPI conditions ($50 \pm 2\%$ RH and $72 \pm 1.8^\circ$ F).

Individual linting test results can be quite variable, thus, the above-described linting test may provide results having a reproducibility which, in terms of absolute numbers, is only fair. In terms of relative ranking, however, the reproducibility of such tests has been found to be very good and thereby provide a valuable relative measure of fabrics and their tendency to generate lint.

Total Energy or "Cup Crush"

The total energy of a nonwoven fabric may be measured according to the "cup crush" test. The cup crush test evaluates fabric stiffness by measuring the peak load (also called the "cup crush") required for a 4.5 cm diameter hemispherically shaped foot to crush a 23 cm by 23 cm piece of fabric shaped into an approximately 6.5 cm diameter by 6.5 cm tall inverted cup while the cup shaped fabric is surrounded by an approximately 6.5 cm diameter cylinder to maintain a uniform deformation of the cup shaped fabric. An average of between 5 and 10 readings may be used to determine the final value, a smaller number of readings is appropriate when there is little or no variability in the individual readings while a larger number of readings is preferred when there is greater variability in the readings. The foot and the cup are aligned to avoid contact between the cup walls and the foot which could affect the readings. The foot descends at a rate of about 0.25 inches per second (380 mm per minute).

The cup crush test yields a value for the total energy required to crush a sample (the "crush energy") which is the total energy from the start of the test to the peak load point. The total or crush energy is calculated by determining the area under the curve formed by the load in grams on one axis and the distance the foot travels in millimeters on

the other from the start of the test to the peak load. The crush energy is, therefore, reported in gm-mm.

Lower cup crush values indicate a less stiff fabric which is generally also considered a softer fabric. A suitable device for measuring cup crush is a model TD-G-500 load cell
5 (500 gram range) available from the Schaevitz Company, Pennsauken, N.J.

Peak Tensile Strength

The peak tensile strength of the samples was determined using a strip tensile test
10 well known in the art. The samples are prepared by first cutting a 7 inch by 7 inch section of wipe and adding solution to the wipe whereby the wipe contains solution in the amount of 330% of the dry weight of the wipe. The solution is the same solution as is used with Huggies® Wet Wipes which are commercially produced by Kimberly-Clark Corp. having offices in Neenah, WI (deionized water may be used as an alternative solution). A $1 \pm$
15 0.04 inch (25 ± 1 mm) by 6 ± 0.04 inch (150 ± 1 mm) sample is then cut from the saturated wipe with the test direction (machine or cross direction) running parallel to the longer side of the strip. The edges on the sample must be clean cut and parallel.

A Constant Rate of Extension unit (or tensile tester) equipped with an appropriate load cell and computerized data acquisition system is used to perform the test.
20 Appropriate tensile testers and load cells may be obtained from Instron Corp. of Canton, MA or Sintech, Inc. of Research Triangle Park, NC.

The grips of the tensile tester are installed parallel to each other. The tensile tester settings are as follows: the crosshead speed is set at 12 ± 0.04 inch/min (300 ± 10 mm/min); the Chart is set at 12 ± 0.04 inch/min (300 ± 10 mm/min); the gage length
25 (measured from the center of the upper horizontal line clamp to the center of the bottom horizontal line clamp) is set at 3.0 ± 0.04 inch (76 ± 1 mm); and the Fail (Break Criterion) is 65%.

The test is conducted by placing the specimen symmetrically in the clamps with the longer dimension being parallel to the direction of the load application. The crosshead is
30 then started and allowed to continue until the sample fails. The maximum load measured is recorded as the Peak Tensile Strength. The peak tensile energy and peak stretch may also be determined using the data from this test.

The peak tensile strength of the tested codes was determined in both the machine direction (MD) and cross-machine direction (CD) of the material.

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Sample Comparison

The various samples were compared using the above-described testing procedures. The results of these tests are presented below:

Code	Basis Weight ¹	Linting ²	Cup Crush ³	Peak Tensile Strength ⁴		Peel Strength ⁵
				MD	CD	
1 (PE Control)	55.6	57.4	905	404	163	5.7
1 (PP Control)	53.6	61.8	1029	372	168	4.0
2	52.4	34.1	1002	349	159	-*
3	57.4	21.2	1136	422	163	27.2
4	52.6	35.8	760	281	95	8.1
5	52.4	25.7	858	200	82	5.8
6	53.1	39.0	952	404	159	4.0

5

1 Actual Basis Weight in grams per square meter (gsm)

2 Quantity of lost lint in milligrams/300 seconds

3 Cup crush value in gram-millimeters (g-mm)

4 Load in grams

10 5 Peel strength in grams/5.08 centimeter width (grams/2 inch width)

* The value of the peel strength for code 2 could not be determined because of ply failure prior to separation.

As demonstrated by the test results presented above, codes 2 and 3 provided reduced linting while code 3 demonstrated significantly higher peel strength than the control codes. A peel strength for code 2 was not determined because the plys failed prior to peeling. This was interpreted as an indication of very elevated peel strength. (Once the peel strength exceeds the failure load of the plys being attached, further increases in the peel strength are of limited value.) These results also indicate that the incorporation of the sampled additive in the polyethylene fibers provided greater pulp capture and increased ply attachment. These results, however, were also accompanied by an increase in the cup crush value for codes 2 and 3. An increase in the cup crush value indicates an increase in the stiffness of the basesheet which generally translates as a decrease in softness. Subjective tactile comparisons also indicated that increased pulp capture and peel strength values were accompanied by reduced softness for codes 2 and 3.

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These test results also demonstrate that the use of additives with polypropylene fibers can be effective in adjusting the physical parameters of the basesheet. As can be seen by a comparison of the cup crush values, codes 4-6 all had a lower stiffness than the

PP control code (which was formed in the same manner as codes 4-6) and two of these samples even had a lower stiffness than the PE control code. These results, however, were also generally accompanied by a decrease in tensile strength.

5 The sample results presented above provide a demonstration that the incorporation of additives in either the polyethylene or polypropylene fibers of a multi-layered wet wipe basesheet provides the ability to modify the physical properties of the resulting multilayered basesheet. The layers may then be chosen and combined to produce a basesheet having the appropriate balance of properties desired for the intended use of the resulting wet wipe.

10 While the invention has been described in detail with respect to the specific aspects thereof, it will be appreciated that those skilled in the art, upon attaining an understanding of the foregoing, may readily conceive of alterations to, variations of, and equivalents to these aspects.

What is claimed is:

1. A nonwoven layered wet wipe basesheet, said basesheet comprising:
a first layer including polypropylene fibers, said first layer having oppositely disposed first and second major surfaces;
a second layer including polyethylene fibers, said second layer having an inward facing major surface and an oppositely disposed outward facing major surface, said inward facing surface being oriented towards and contacting said first major surface and said outward facing surface defining an exterior surface of said basesheet; and
an additive, said additive present in one of said polypropylene fibers or said polyethylene fibers.
- 5 2. The basesheet of claim 1 wherein said additive is present in said polypropylene fibers of said first layer.
- 10 3. The basesheet of claim 2 wherein said first layer further comprises natural fibers.
4. The basesheet of claim 3 wherein said natural fibers and said polyethylene fibers are homogeneously mixed and said natural fibers comprise at least about 50 percent, by dry weight, of said second layer.
5. The basesheet of claim 2 wherein said second layer further comprises natural fibers.
6. The basesheet of claim 2 wherein said first and second layers each further comprise natural fibers.
7. The basesheet of claim 6 wherein said natural fibers of said first and second layers are homogeneously mixed with said polypropylene fibers and said polyethylene fibers.
8. The basesheet of claim 7 wherein said natural fibers comprise at least about 50 percent, by dry weight, of each of said first and second layers.
9. The basesheet of claim 2 wherein said additive includes polybutylene or atactic polypropylene.

10. The basesheet of claim 1 wherein said additive is present in said polyethylene fibers of said second layer.
11. The basesheet of claim 10 wherein said first layer further comprises natural fibers.
12. The basesheet of claim 10 wherein said natural fibers and said polyethylene fibers are homogenously mixed and said natural fibers comprise at least about 50 percent, by dry weight, of said second layer.
13. The basesheet of claim 10 wherein said second layer further comprises natural fibers.
14. The basesheet of claim 10 wherein said first and second layers each further comprise natural fibers.
15. The basesheet of claim 14 wherein said natural fibers of said first and second layers are homogenously mixed with said polypropylene fibers and said polyethylene fibers.
16. The basesheet of claim 15 wherein said natural fibers comprise at least about 50 percent, by dry weight, of each of said first and second layers.
17. The basesheet of claim 10 wherein said additive includes a fully hydrogenated hydrocarbon resin.
18. The basesheet of claim 17 wherein said second layer further comprises natural fibers.
19. The basesheet of claim 10 wherein said polyethylene fibers having said additive present therein have a melting temperature which is at least about 40 degrees Celsius less than the melting temperature of virgin polyethylene.
20. The basesheet of claim 19 wherein said second layer further comprises natural fibers.

21. The basesheet of claim 20 wherein said first layer further comprises natural fibers.
22. The basesheet of claim 10 wherein said polyethylene fibers having said additive present therein have a melting temperature of about 87 degrees Celsius.
23. The basesheet of claim 1 wherein each of said first and second layers further comprises natural fibers homogenously mixed within said respective first and second layers.
24. The basesheet of claim 23 wherein said natural fibers present in said first and second layers comprise at least about 50 percent, by dry weight, of each of said first and second layers.
25. A nonwoven layered wet wipe basesheet, said basesheet comprising:
an inner layer including polypropylene fibers, said inner layer having oppositely disposed first and second major surfaces;
5 first and second outer layers, each of said outer layers including polyethylene fibers, each of said outer layers having an inward facing major surface and an oppositely disposed outward facing major surface, said inward facing major surfaces of said first and second outer layers being respectively in contact with said first and second major surfaces of said inner layer, said outward facing major surfaces of said first and second
10 outer layers defining two oppositely disposed major exterior surfaces of said basesheet; and
an additive, said additive present in one of said polypropylene fibers of said inner layer or said polyethylene fibers of said first and second outer layers.
26. The basesheet of claim 25 wherein said additive is present in said polypropylene fibers of said inner layer.
27. The basesheet of claim 26 wherein said additive includes polybutylene or atactic polypropylene.
28. The basesheet of claim 25 wherein said additive is present in said polyethylene fibers of said first and second outer layers.

29. The basesheet of claim 28 wherein said additive includes a fully hydrogenated hydrocarbon resin.

30. The basesheet of claim 29 wherein said first and second outer layers further comprise natural fibers.

31. The basesheet of claim 30 wherein said inner layer further comprises natural fibers.

32. The basesheet of claim 29 wherein said polyethylene fibers having said additive present therein has a melting temperature which is at least about 40 degrees Celsius less than the melting temperature of virgin polyethylene.

33. The basesheet of claim 29 wherein said polyethylene fibers having said additive present therein have a melting temperature of about 87 degrees Celsius.

34. The basesheet of claim 25 wherein each of said inner and outer layers further comprises natural fibers homogenously mixed within said respective inner and outer layers.

35. The basesheet of claim 34 wherein said natural fibers present in said inner and outer layers comprise at least about 50 percent, by dry weight, of each of said inner and outer layers.

36. A wet wipe comprising:

a nonwoven basesheet having a fibrous first layer and a second layer;
said fibrous first layer having oppositely disposed first and second major surfaces;

5 and

said second layer including a plurality of fibers, said second layer having an inward facing major surface and an oppositely disposed outward facing major surface, said inward facing major surface being oriented towards and contacting said first major surface and said outward facing major surface defining an exterior surface of said basesheet, and
10 wherein said plurality of fibers are formed by a blend including polyethylene and an additive; and

a solution disposed in said basesheet.

37. The wet wipe of claim 36 wherein said additive includes a fully hydrogenated hydrocarbon resin.
38. The wet wipe of claim 36 wherein said blend has a melting temperature of less than about 90 degrees Celsius.
39. The wet wipe of claim 36 wherein each of said first and second layers further comprises natural fibers homogenously mixed within said respective first and second layers.
40. The wet wipe of claim 39 wherein said natural fibers present in said first and second layers comprise at least about 50 percent, by dry weight, of each of said first and second layers.
41. A wet wipe comprising:
a nonwoven basesheet having a first layer and a fibrous second layer;
said first layer including a plurality of fibers, said first layer having oppositely
5 disposed first and second major surfaces, and wherein said plurality of fibers are formed
with a blend including polypropylene and an additive;
said fibrous second layer having an inward facing major surface and an oppositely
disposed outward facing major surface, said inward facing major surface being oriented
towards and contacting said first major surface and said outward facing major surface
10 defining an exterior surface of said basesheet; and
a solution disposed in said basesheet.
42. The wet wipe of claim 41 wherein said additive includes polybutylene or atactic polypropylene.
43. The wet wipe of claim 41 wherein each of said first and second layers further comprises natural fibers homogenously mixed within said respective first and second layers.
44. The wet wipe of claim 43 wherein said natural fibers present in said first and second layers comprise at least about 50 percent, by dry weight, of each of said first and second layers.

INTERNATIONAL SEARCH REPORT

Int. Appl. No.
PCT/US 99/31289

A. CLASSIFICATION OF SUBJECT MATTER
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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A47L A47K A61K D04H D01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 456 044 A (KIMBERLY CLARK CO) 13 November 1991 (1991-11-13) cited in the application claims	1-44
A	WO 98 03713 A (KIMBERLY CLARK CO) 29 January 1998 (1998-01-29) the whole document	1-44
A	EP 0 564 784 A (KIMBERLY CLARK CO) 13 October 1993 (1993-10-13) page 9, line 39 -page 10, line 13	1-44
A	US 4 604 313 A (MCFARLAND TIMOTHY M ET AL) 5 August 1986 (1986-08-05) the whole document	1-44
	-/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
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- "&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

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PCT/US 99/31289

C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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